6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

A RIGOUROUS DERIVATION OF THE INTERFACE CONDITIONS IN LINEAR POROELASTIC COMPOSITES

M. Serpilli

Department of Civil and Building Engineering, and Architecture, Università Politecnica delle Marche, via brecce bianche 60131 Ancona, Italy, E-mail: m.serpilli@univpm.it

Keywords: *Asymptotic analysis, Poroelasticity, Composites, Interface Models*

The modeling of complex structures obtained by joining simpler elements with highly contrasted geometric and/or material characteristics represents a source of a variety of problems of practical importance in all fields of engineering. In the present work we undertake a rigorous derivation of the interface conditions between two poroelastic solids separated by a thin poroelastic interphase layer by means of an asymptotic analysis, following the approach by [1, 2, 3, 4]. The goal of the present work is to identify the interface limit models of a linear poroelastic composite constituted by a thin poroelastic layer surrounded by two poroelastic bodies. The mechanical behavior is described by the quasi-static Biot equations of linear poroelasticity. By defining a small parameter ε, associated with the thickness and the constitutive properties of the middle layer, we perform an asymptotic analysis by letting ε tend to zero. We analyze different situations by varying the stiffnesses ratios between the middle layer and the adherents. This parametric analysis draws the attention to three significant cases: namely, the *soft* poroelastic interface, where the material coefficients of the intermediate domain have order of magnitude ε with respect to those of the surrounding bodies; the *hard* poroelastic interface, where the costitutive parameters have the same order of magnitude; finally, the *rigid* poroelastic interface, where the rigidities have order of magnitude $\frac{1}{\varepsilon}$. We characterize the limit transmission problem at order zero, the first corrector term of the asymptotic expansion, giving a more precise approximation of the actual mechanical behavior, and we identify the ad hoc transmission conditions at the interface between the two neighbouring bodies in terms of the jump of stresses, displacements and pressure.

REFERENCES

[1] A.-L. Bessoud, F. Krasucki and M. Serpilli, Asymptotic analysis of shell-like inclusions with high rigidity, *J. Elasticity*, Vol. **103**, pp. 153-172, 2011.

[2] G. Geymonat, F. Krasucki and S. Lenci, Mathematical analysis of a bonded joint with a soft thin adhesive, *Math. Mech. Solids*, Vol. **4**, pp. 201-225, 1999.

[3] R. Rizzoni, S. Dumont, F. Lebon and E. Sacco, Higher order models for soft and hard elastic interfaces, *Int. J. Solids Struct.*, Vol. **51**(23-24), pp. 4137-4148, 2014.

[4] M. Serpilli, Mathematical modeling of weak and strong piezoelectric interfaces, *J. Elasticity*, Vol. **21**(2) pp. 235-254, 2015.